Remarks

In view of the above amendments and the following remarks, reconsideration and further examination are requested.

Claims 16-21 have been withdrawn from consideration as being directed to a non-elected invention. In view of this restriction by original presentation, claims 16-21 have been canceled without prejudice or disclaimer to the subject matter contained therein.

Claims 1, 2, 4, 5 and 7-15 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Takahashi (US 5,672,091) in view of Stephan (AU 245213) and Kanzawa (US 5,674,109).

Claims 2 and 9 have been canceled without prejudice or disclaimer to the subject matter contained therein and features similar to those of these claims have been added to claims 1 and 7, respectively.

Claims 12-14 have been amended so as to be dependent from claim 8 in light of the cancellation of claim 9.

Claims 1 and 7 have also been further amended so as to further distinguish the present invention from the references relied upon in the above-mentioned rejection. Further, claim 8 has also been amended.

In addition, new claims 22-25 have been added.

The above-mentioned rejection is submitted to be inapplicable to the claims for the following reasons.

Claim 1 is patentable over the combination of Takahashi, Stephan and Kanzawa, since claim 1 recites a polishing apparatus having, in part, a polishing table having a polishing surface; a top ring adapted to hold and rotate a substrate having a semiconductor device thereon and press a surface of the substrate against the polishing surface to polish the surface of the substrate; at least one optical measuring device disposed on a stationary section adjacent to an outer peripheral portion of the polishing table and below the polishing surface of the polishing table, the at least one optical measuring device being operable to measure a thickness of a layer formed on the surface of the substrate; and at least one notch formed in the outer peripheral portion of the polishing table, the at least one notch allowing light emitted from the at least one optical measuring device to pass

therethrough and be incident on the surface of the substrate and allowing light reflected from the surface of the substrate to pass therethrough and be incident on the at least one optical measuring device, wherein the top ring is swingable so that the light emitted from the at least one optical measuring device is incident on at least a central portion of the substrate. The combination of Takahashi, Stephan and Kanzawa fails to disclose or suggest the at least one notch formed in the outer peripheral portion of the polishing table, wherein the top ring is swingable so that the light emitted from the at least one optical measuring device via the at least one notch is incident on at least the central portion of the substrate having the semiconductor device thereon.

Takahashi discloses a polishing apparatus having an end point detection device. The polishing apparatus has a top ring 2 operable to hold a wafer F against a turntable 1 to polish a surface of the wafer F. The polishing apparatus also has a detection device including a beam emitter section 3 and a beam receiver section 4. The beam emitter section 3 and the beam receiver section 4 are positioned beyond an outer most edge of the turntable 1. When the wafer F being polished is to be checked to determine whether the polishing has been completed, the top ring 2 moves the wafer F laterally so that a peripheral edge portion of the polished surface of the wafer F overhangs the turntable 1 above the location of the beam emitter section 3 and the beam receiver section 4 of the detection device. The detection device then inspect the periphery of the wafer F to determine if the polishing of the wafer F has been completed. (See column 3, lines 44-67 and Figure 1).

Based on the above discussion, it is apparent that Takahashi fails to disclose or suggest that the turntable 1 has at least one notch formed in an outer peripheral portion thereof. Further, Takahashi fails to disclose or suggest that the top ring 2 is swingable such that the light emitted from the beam emitter section 3 via at least one notch is incident on at least the central portion of the wafer F. Instead, Takahashi only discloses that the peripheral edge portion of the wafer F is analyzed to determine whether the polishing is complete.

In the combination, Stephan is relied upon as disclosing at least one notch in a turntable. Stephan discloses a grinding disc 1 with a number of windows 2 and marginal slots 3 located therein. The positioning of the windows 2 and the marginal slots 3 is such that when the grinding disc 1 is

rotated, an optical effect is created which results in an object on a side of the grinding disc 1 opposite the viewer to appear to be completely visible. (See page 3, lines 6-25 and Figures 1 and 2).

Also in the combination, Kanzawa is relied upon as disclosing a top ring that is swingable. Kanzawa discloses a top ring 4 that holds a workpiece 3 during polishing. The top ring 4 is connected to an arm 5 that is able to swing back and forth on an abrasive cloth 2. (See column 5, lines 11-60 and Figure 2A).

While Stephan and Kanzawa disclose the grinding disk 1 with a number of slots 3 and the swingable top ring 4, the combination of these references with Takahashi fails to disclose or suggest a top ring that is swingable so that light emitted from at least one optical measuring device via at least one notch is incident on at least a central portion of a substrate having a semiconductor device thereon.

In order to detect whether or not a substrate having a semiconductor device located thereon has been sufficiently polished, it is beneficial to measure a fixed point of the substrate because semiconductor devices usually have both a metal underlying layer and an insulating underlying layer. When light is applied to a surface of the substrate to determine whether the polishing of the substrate is complete, the light is influenced by the underlying layer located below the surface of the substrate. Therefore, when the light is reflected by the substrate, the reflected light is different depending on whether the underlying layer is the metal layer or the insulating layer. Since variations in reflected light are measured during an endpoint detection process to determine whether or not the polishing is complete, if the reflected light is measured at different points on the surface of the substrate having different underlying layers (the metal layer versus the insulating layer), then accurate endpoint detection cannot be achieved. This inaccuracy in detection occurs in Takahashi because the peripheral edge portion of the wafer F is used to determine whether or not the polishing of the wafer F is complete.

In Takahashi, the wafer F is polished by rotating the top ring 2 for a period of time. Then, the top ring 2 moves the wafer F laterally off of the turntable 1 to the extent that the beam emitter section 3 and the beam receiver section 4 of the detection device can measure a section of the peripheral edge portion of the wafer F to determine whether the polishing of the wafer F is complete.

If the polishing of the wafer F is not complete, the top ring 2 slides the wafer F back onto the turntable 1 and the polishing operation is continued by rotating the top ring 2 while the wafer F is pressed against the turntable 1. After another period of time, the top ring 2 again moves the wafer F laterally off of the turntable 1 to the extent that the detection device can measure the peripheral edge portion of the wafer F a second time to determine whether the polishing of the wafer F is complete. However, since the wafer F has been rotated during the polishing operation, there is little chance that the same section of the peripheral edge portion of the wafer F will be measured as was initially measured by the detection device. Therefore, if the initial measurement was taken from a section of the peripheral edge portion of the wafer F that had the metal underlying layer and the second measurement was taken from a section of the peripheral edge portion of the wafer F that had the insulating underlying layer, the differences in these measurements caused by the different underlying layers with result in inaccuracies in detecting whether or not the polishing of the wafer F is complete.

In contrast, the present invention as recited in claim 1 operates such that light emitted from the at least one optical measuring device via at least one notch is incident on at least a central portion of a substrate having a semiconductor device thereon. Therefore, by applying the light to the central portion of the substrate, the same area will always be measured because the central portion of a substrate remains fixed regardless of the rotation of the substrate. As a result, the present invention allow for a more accurate determination as to when the polishing of the substrate is complete.

In view of the above discussion, it is apparent that the combination of Takahashi, Stephan and Kanzawa fails to disclose or suggest the present invention as recited in claim 1.

As for claims 7 and 24, they are patentable over the combination of references relied upon in the rejection for similar reasons as set forth above in support of claim 1. That is, claims 7 and 21, similar to above claim 1, recite, in part, a thickness measuring device disposed on a stationary section for measuring a thickness of a layer formed on a surface of a substrate, the thickness measuring device being arranged so that a notch of a polishing surface and the thickness measuring device are aligned with each other, wherein a top ring is swingable so that a central portion of the substrate

moves onto the notch of the polishing surface, which features are not disclosed or suggested by the combination of the references.

Because of the above mentioned distinctions, it is believed clear that claims 1, 4, 5, 7, 8, 10-15 and 22-25 are patentable over the combination of Takahashi, Stephan, and Kanzawa. Furthermore, it is submitted that the distinctions are such that a person having ordinary skill in the art at the time of invention would not have been motivated to make any combination of the references of record in such a manner as to result in, or otherwise render obvious, the present invention as recited in claims 1, 4, 5, 7, 8, 10-15 and 22-25. Therefore, it is submitted that claims 1, 4, 5, 7, 8, 10-15 and 22-25 are clearly allowable over the prior art of record.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance. The Examiner is invited to contact the undersigned by telephone if it is felt that there are issues remaining which must be resolved before allowance of the application.

Respectfully submitted,

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